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Several studies on the question of overt versus covert responses were reviewed. Of the ten studies discussed, five supported the position of overt response. The others showed no significant differences between response modes except that learning efficiency was lower in the overt response condition in comparison with the covert and reading conditions.

A study concerned with the question of overt and covert response in terms of degrees of written activity was described. The effects of covert activity upon retention, time comparisons for each mode presented, and effects of looking at confirmation responses before responding were investigated. The study used a 208-frame linear program on counterinsurgency (COIN); all cues were removed after the initial response. Four treatment groups were used. The booklet group students had no opportunity to look at correct responses. The answer sheet group students could look at the confirming response. The criterion frames group students wrote responses in criterion frames only. The covert group students were not required to make any written response. Immediate and delayed retention tests were administered, and there was no significant difference in the mean scores on these tests.

Results indicated that the degree of student activity was unimportant. Learning levels for various degrees of written activity were not significantly different. Limited moter activity was more efficient than written activity in terms of training time and achievement.

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Some Effects of Differing Degrees of Written Activity in a Linear Programmed Instruction Package

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Some Effects of Differing Degrees of Written Activity in a Linear Programmed Instruction Package

Among the several issues of concern to those who are attempting to determine how programmed instruction ensures the most efficient learning is one concerning mode of response. Specifically, there are two types of questions. The first relates to the efficiency of multiple-choice vs. constructed response activity. The second question concerns whether the learner should write out his response, commonly referred to as an overt response, or can he "think" the response just as efficiently.

Over the past two or three years a number of studies have been directed at the question of overt vs. covert responsing. The results have not been unequivocal. Krumboltz (1961), for example, reviewed available studies and concluded that although the evidence seemed to support the presumption of the importance of the overt response, the question should not be considered settled. On the other hand, Silberman (1962) in a later review wrote that in general the covert response seemed to result in more efficient learning. Both Krumboltz and Silberman pointed out, however, that the studies they reviewed utilized short programs of approximately 100 items and very few used any measure of retention.

The remainder of this paper reviews available studies on the question of covert and overt responding and describes a study in which the question of overt and covert responding was investigated. In this study response activity was indicated by the degrees of written activity, the degrees of overt responding depending upon the degrees of written activity and covert responding being defined as no written activity.

Literature Review

The studies available pertaining to the question of covert and overt responding have involved several different methods of response. The experimental arrangements have ranged from "reading programs" in which students simply read the programmed materials, to multiple-choice answers, to "thinking answers," and to completely written or constructed response. As both Drumboltz and Silberman point out, many of these studies utilize short programs of 100 frames or less and few used any measures of retention. Nevertheless, the studies which are reviewed below invariably provided some comparison between strictly covert (or thinking responses) and overt (or written constructed responses).

The emphasis on the importance of overt responding can be traced to Skinner (1954, 58) who emphasized the necessity for the learner to respond in a stimulus situation. Holland (1960a) states

that learning takes place when it is emitted and immediately reinforced. The Holland-Skinner position seems to be the strongest position about the question concerning overt vs. covert responding in available literature, and at this point in time, overt responding is called for in linear programs being produced commercially and in military training programs.

Five available studies support the position of overt responding. Holland (1960b) reported that students completing a conventional linear program achieved significantly more than students who only read the program. The overtly responding group, however, used more time to complete the program. Ripple (1963), using 240 college students and a 134-frame program, showed results favoring overt responding. In his study he compared a conventional linear program requiring responses in each frame with a conventional program which students read. He concluded on the basis of his findings that students who were actively involved learned more efficiently. Students using the conventional linear programmed instruction materials also did significantly better on a written test administered ten days later.

In a study involving 30 undergraduate students in a short program on basic electricity, presented on a Skinner disc machine, students who filled in the blanks did better than those who read the

program. Mean errors on an eight-item test showed 1.80 errors for the constructed response group and 2.76 errors for the reading group. With df = 58, the t-ratio was 2.76 (Silvermann and Alter, 1960). Krumboltz and Weisman (1962) employed 54 undergraduate students who completed a 177-frame program relating to conceptual understanding. They studied three types of responses: reading responses, covert responses in which subjects mentally composed the responses, and reading in which the subjects read the program in which the response blanks had been completed. Criterion tests consisting of 50 items measuring student understanding of concepts were employed. T-tests revealed no significant differences between groups on a test given immediately upon completion of training. On a retention test administered two weeks later the written response group was significantly higher than the covert and reading groups. Students recorded the amount of time they spent on the program and mean time scores were computed for each group. A covariance analysis of efficiency scores obtained from a ratio of the amount learned per unit of learning time revealed that the overt response condition resulted in relatively low efficiency, in comparison with the reading and covert conditions.

Fry (1959) reported a study of constructed responses vs. multiple-choice responses. Since the students made no motor response, the multiple-choice method can be considered a covert condition. His results favored the constructed response when the criterion test measured recall.

Other studies show results which either favor covert responding or no differences between response mode. Roe (1961, 1962) employed a 230-frame program with 186 freshman engineering students in four ways. The program was presented on a Skinner-type free response machine, a multiple-choice machine, a programmed text requiring overt response, and a programmed text requiring no overt response. There were no significant differences between groups on post-test scores. He concluded that for college level students, thinking the answer is as good as psychomotor performance such as writing.

With elementary school children in the fourth and sixth grades, Lockard and Sidowski (1961) obtained differential results. They presented nonsense syllables under three sensory modes (auditory, visual, and auditory-visual) to fourth and sixth grade children who had been randomly assigned to overt and covert responding groups. For the entire group there were no differences between overt and covert groups. When scores were

analyzed by grade level, however, fourth graders who wrote their responses did significantly better. The investigators concluded that for sixth grade children the covert response allowed them to organize the material they were learning better than the overt responses. Since this was not true for fourth grade children, age level may be a variable in the question of overt and covert responding.

In another study involving elementary age children Keislar and McNeil (1962) found no significant differences between overt and what they call implicit responses. In the study both experimental groups were taught by a videosonic teaching machine which projected slides and played a commentary to the learner through ear phones. The program involved 432 multiple-choice frames dealing with physical science. Children in the overt response group were required to press a button for the correct response before the program would advance. Children in the implicit response group were not required to press any buttons or make any overt response. The program was presented automatically.

Goldbeck and Campbell (1962) devised a 32-frame program on the topic of light and administered this to 62 eighth grade students of comparable ability on school and college ability tests under four conditions. These four response modes were overt; optional, in

which the student could write his response if he was sure it was correct or if he was not sure it was correct he could leave the blank empty; covert, in which the student was to think the correct response; and reading, in which the correct response was printed in the response blank. There were no significant differences between groups on a post-test administered upon completion of training. On the retention test administered ten days later co-variance analysis revealed significant differences. The reading group increased its superiority over other groups to a significant level. In the amount of time to complete the program, both the overt and optional groups had significantly higher learning times than the other two groups. Learning efficiency as determined by the amount of time and extent of learning favored the reading and covert groups.

In a study related to the question of covert and overt responding, Silberman et al (1961) did not find significant differences between groups who read a program and students who completed the program in the more conventional fashion. The reading group, however, took significantly less time. Pressey (1963) and Silvermann (1960) report similar results, covert or reading response groups doing equally as well as overt responding groups.

Discussion

The basis for constructed response or overt responding seems to arise from what is postulated to be a need for student activity (Holland, 1960a). In reality the question may be one of evidence of student activity. Since thinking or covert responding is not observable, it may be that an unfortunate dichotomy of overt vs. covert responding has developed when, in effect, it is relevant student activity that is desirable rather than the actual psychomotor act of response writing emphasized by overt responding. Goldbeck and Campbell (1962), in fact, make an important point when they state that overt responding may be performed in a quite perfunctory manner with little or no active responding other than the motor response of writing. They suggest that such responses may be considered copied responses rather than constructed responses and may produce what they term an illusion of learning. In their study (mentioned above) they varied cues and prompts as a means of increasing and decreasing program difficulty levels. As difficulty level increased to the intermediate stage, the test performance of an overt response group improved "dramatically and significantly" (Goldbeck and Campbell, 1962, p. 112). For lower difficulty levels, however, the overt group made significantly lower

criterion test scores than covert responding groups. For difficult levels, there were no significant differences. They concluded that the value of requiring a constructed response apparently depends on the conditions under which a response is made. More exactly, perhaps, the value of constructed responding may lie in the type of cueing and prompting used.

The matter of difficulty level raised by the Goldbeck and Campbell (1962) study and the differing results occurring from overt and covertly responding groups as difficulty level increases and decreases is important. A question is raised, however, about their findings since at least two types of linear programming are now apparent. One type, as Silvermann and Alter (1960) pointed out, is based on the position that responding in a frame is not for the purpose of the student learning the specific response but is used instead to assure learner attention to the information to be learned on the verbal portion of the frame. In this type of linear program, cueing and prompting follows a visual mode, such as underlining the desired response word and the use of first letters or missing letters from the word. The other type is one of lengthened construction type criterion frame in which the learner is trained to make a response to a stimulus context situation presented in a series of frames. His response is lengthened

until such time that he can make the total response when he is presented without any cues or prompting. In the first type, single-word responses are typical, while in the second, entire phrases in which the total response context is required are typical. The Goldbeck and Campbell findings may apply to the first type of linear program but not to the second, since in the second type of program, cueing and prompting takes a different form. The cues and prompts are provided within the stimulus context. Frame difficulty is more a matter of the extent of practicing the response than it is a matter of cueing and prompting.

In the studies reviewed above, the type of linear program was not shown, leaving open the question of response mode and type of program. Hypothesizing that the type of linear program may influence the efficiency response mode, the following study was designed to investigate the effects of varying degrees of observable student activity and covert responding in a lengthened-construction type linear program, as well as comparisons of amount of time required for completion of the program under each of the response modes.

In addition, the study sought information pertaining to a related problem. An earlier study (unpublished) revealed evidence

suggesting that students peeked at confirming frames before responding and that this peeking adversely affected criterion test scores. In developing the linear program used in this study (described below), the final mass tryout with more than 50 students revealed that frame error rates were less than one percent. Further, the criterion frame error rate was less than one percent. On the criterion test which was made up of the criterion frames extracted from the program, however, error rate was up to 35 percent. On looking at student responses in the program there was evidence that they had merely copied the correct response in the proper places.

Thus, three problems were investigated:

1. The differing effects of various degrees of observable student activity, defined as various degrees of written activity, and covert activity upon retention.

2. Time comparisons for each of the modes of presentation.

3. Effects of students' being able to peek at confirmation responses before responding.

In each case, the null hypothesis of no differences was tested at the .05 level.

Description of the Study

The study used a 208-frame linear program on counterinsurgency (COIN). This program was locally developed and revealed on mass testing prior to the study that more than 95 percent of the students responded correctly on each frame and criterion frame. The program is a lengthened constructed response linear program that depends on the student's making his initial response from contextual cues in the frame in which he responds. Once the initial response is made, cues are removed and the student practices the response in its proper context. No first letter, underline, or other visual clues are used. When the student responds to a criterion frame, he has no cues to the correct response. He can make the response to the stimulus context or he cannot.

The objective of the COIN program is to provide basic airmen with knowledge of terminology and techniques of insurgency and COIN. As such the program was concerned with definitions and the what, when, where, and how of counterinsurgency.

Subjects were airmen undergoing basic military training at the Lackland Military Training Center. Airmen were assigned to four treatment groups as follows:

1. Booklet group in which students wrote their response in the booklet. This booklet was constructed so that students had no opportunity to look at the correct response before they responded.

2. Answer sheet group in which students wrote their responses on answer sheets provided. The students of this group could look at the confirming responses before they responded.

3. Criterion frames group in which students wrote responses to criterion frames only.

4. Covert group in which no written response was required. If the student responded at all it was to think the responses or say it silently.

Since training was intended to enable airmen to identify terms and techniques, a multiple-choice test, consisting of 20 items, was devised. The test was constructed by using the criterion frames from the program. One of the four response choices provided for each item was the response called for in the criterion frame from which the item stem was taken. The multiple-choice test was administered twice. The first administration came immediately after training to measure immediate learning. Ten days later the test was readministered to measure retention.

Analysis

Complete data was available upon completion of the study on 42 subjects who completed the first test. Because of administrative reasons, complete data was available on only 27 subjects for the retention test. Test scores for each group were recorded and mean scores computed. Differences were tested by the t-test (Edwards, 1960) with the .05 level as the criterion.

Completion times were also recorded. The number of subjects for each group varied, the number ranging from 46 to 271. Differences between mean completion times were also tested at the .05 level.

General aptitude index scores from the Airmen Qualifying Examination were obtained on each airman. Mean scores and range scores for each group were tested and no differences were found. The conclusion was that the groups were comparable in aptitude.

Results and Conclusions

Mean scores on the immediate and delayed retention tests are shown in Table 1. Comparison of mean test scores for the Booklet, criterion frames, and covert groups reveal that there are no significant differences on the immediate and dealyed

retention tests. The mean score of the answer sheet group did not differ significantly from the other three groups on either test. One feature of the data of Table 1 is that the mean scores for each group increased over the ten-day retention period. These increases, as tested by the t-test for correlated means (Edwards, 1960), were not significant. On the basis of these results, the extent of written activity in this program seems unimportant.

A comparison of the mean scores of the booklet and Answer Sheet groups reveals no significant difference on either test. Thus, peeking opportunity did not adversely affect results for these students on this program.

Table 1

Mean Scores for Each Treatment Group on Immediate and Delayed Retention Tests

Treatment Group	N	Immediate Retention	N	Delayed Retention
Booklet	42	15.3	27	15.4
Answer Sheet	42	16.6	27	17.1
Criterion Frames	42	16.2	27	17.0
Covert	42	16.0	27	16.3

No differences between treatments are significant (.05)

Table 2

Mean Times for Each Treatment Group to Complete the 208-Frame Linear Program (in minutes)

Treatment Group	N	Mean	S.D.
Booklet	96	116.46	30.94
Answer Sheet	271	140.99	27.25
Criterion Frames	46	85.33	11.53
Covert	46	89.46	8.55

Each treatment is significantly different from other treatments (.05)

Mean time comparisons, shown in Table 2, revealed significantly different results for each group. The Criterion Frames Group used the least amount of time, closely followed by the Covert Group. The Booklet Group was third and the Answer Sheet Group last. Of interest are the standard deviations. Here the Covert Group has the least range, leading to the implication that for practical purposes the covert mode of response is more efficient for this program.

Conclusions and Discussion

The results of this study indicate that the degree of student activity are unimportant for this program. While the results should not be generalized, they add to the mounting evidence on the question of overt-covert responding. Farther, the effects of response mode in one lengthened constructed response type program are now available. Neither should these results be generalized to this type of program. It may be that the response activity mode relates to the criterion for a package. The criterion test was a measure of recognition, appropriately following objectives for the program. If, however, the program objectives had required a different type of criterion test requiring student activity other results may have been expected. Further study of the mode of

responding and such factors as criterion activity, type of program, and learner abilities is needed.

Two other conclusions seem warranted. The first is that peeking does not appear to be an important problem. Second, programs requiring very limited or no motor activity are more efficient in terms of training time and achievement than programs which require constructed responses for all frames.

Finally, one of the early contentions (Porter, 1957; Carr, 1959) was that to be properly classified as auto-instructional, materials must provide opportunity for student response. This contention should not be confused, as suggested earlier, with observable evidence of student response. This study as well as those of Roe (1961, 1962), Lickard and Sidowski (1961), Keislar and McNeil (1962), and Goldbeck and Campbell (1962) reveal that students learned when there was no observable evidence of responses. Because their responding was not observable does not mean students were not responding actively. Reasoning, thinking, and other cognitive processes involve activity that are perhaps much more important for learning in the programmed learning method than is motor activity. As suggested above, further study is needed to determine how student response activity relates to

the criterion activity. Studies of covert-overt responding as now conceived may serve little useful purpose, since there apparently is no dichotomy of overt and covert responding. Rather, response activity as it relates to criterion activity may be more appropriately investigated.

Recommendations

There are no differences in level of learning among various degrees of written activity. Since considerable training time and materials can be saved by writing answers to criterion frames only or using no written responses at all, we recommend that these methods be used for this program.

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